Amendments of the Claims

The following listing of claims will replace all prior versions, and listings, of claims in the above-identified patent application:

Listing of Claims

1. (original) A method of determining a preferred angular orientation of a golf club shaft about a longitudinal axis thereof, said golf club shaft having a proximal end for gripping by a golfer and a distal end for attachment to a golf club head, said method comprising:

immobilizing a first one of said proximal end and said distal end of said golf club shaft;

initiating vibratory motion of a second one of said proximal end and said distal end of said golf club shaft in each of a plurality of vibration planes, each lying at a respective angular position about said longitudinal axis;

for each of said vibration planes, measuring maximum out-of-plane displacement of said second one of said proximal end and said distal end of said golf club shaft;

analyzing said measured displacements; and

calculating from said analyzed measured displacements said preferred angular orientation.

2. (original) The method of claim 1 wherein:

said first one of said proximal end and said distal end of said golf club shaft is said proximal end; and

said second one of said proximal end and said distal end of said golf club shaft is said distal end.

3. (original) The method of claim 1 further comprising mounting a reaction mass on said distal end prior to said initiating.

4. (original) The method of claim 3 wherein said initiating comprises applying an impulse to said golf club shaft in a direction other than parallel to said longitudinal axis.

5. (original) The method of claim 4 wherein said applying an impulse comprises:

displacing said distal end of said golf club shaft in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

6. (original) The method of claim 5 wherein:

said displacing comprises attracting said reaction mass with an electromagnet; and

said releasing comprises deactivating said electromagnet.

7. (original) The method of claim 1 wherein said initiating comprises applying an impulse to said golf club shaft in a direction other than parallel to said longitudinal axis.

8. (original) The method of claim 7 wherein said applying an impulse comprises:

displacing said distal end of said golf club shaft in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

9. (original) The method of claim 1 wherein said measuring comprises:

providing on said shaft at least two energy reflective surfaces at angles oblique to said vibration plane;

directing a respective energy beam at each of said reflective surfaces;

detecting a respective reflected beam reflected from each of said surfaces;

calculating from said detected beams distances of said surfaces from one or more fixed locations during said vibratory motion; and

deriving said out-of-plane displacement from said calculated distances.

10. (original) The method of claim 9 wherein said respective energy beam is a beam of electromagnetic radiation.

11. (original) The method of claim 10 wherein said beam is a light beam.

12. (original) The method of claim 11 wherein said beam is a laser beam.

13. (original) The method of claim 9 wherein:

said first one of said proximal end and said distal end of said golf club shaft is said proximal end; and

said second one of said proximal end and said distal end of said golf club shaft is said distal end; said method further comprising:

mounting a reaction mass on said distal end prior to said initiating; wherein:

said reflective surfaces are on said reaction mass.

14. (original) The method of claim 1 wherein:

said analyzing comprises plotting said out-of-plane displacements as a function of angle about said longitudinal axis; and

said calculating comprises determining a pair of opposed minimum displacements; wherein:

a line connecting said opposed minimum displacements defines said preferred angular orientation.

15-26. (canceled)

27. (original) Apparatus for determining a preferred angular orientation of a golf club shaft about

a longitudinal axis thereof, said golf club shaft having a proximal end for gripping by a golfer and a distal end for attachment to a golf club head, said apparatus comprising:

means for immobilizing a first one of said proximal end and said distal end of said golf club shaft;

means for initiating vibratory motion of a second one of said proximal end and said distal end of said golf club shaft in each of a plurality of vibration planes, each lying at a respective angular position about said longitudinal axis;

means for measuring, for each of said vibration planes, maximum out-of-plane displacement of said second one of said proximal end and said distal end of said golf club shaft;

means for analyzing said measured displacements; and

means for calculating from said analyzed measured displacements said preferred angular orientation.

28. (original) The apparatus of claim 27 wherein:

said first one of said proximal end and said distal end of said golf club shaft is said proximal end; and

said second one of said proximal end and said distal end of said golf club shaft is said distal end.

29. (original) The apparatus of claim 27 further comprising reaction means for mounting on said distal end.

30. (original) The apparatus of claim 29 wherein said means for initiating comprises means for applying an impulse to said golf club shaft in a direction other than parallel to said longitudinal axis.

31. (original) The apparatus of claim 30 wherein said means for applying an impulse comprises:

means for displacing said distal end of said golf club shaft in a direction other than parallel to said longitudinal axis; and

means for releasing said displaced distal end.

32. (original) The apparatus of claim 31 wherein:

said means for displacing comprises an electromagnet for attracting said reaction mass; and

said means for releasing comprises means for deactivating said electromagnet.

33. (original) The apparatus of claim 27 wherein said means for initiating comprises means for applying an impulse to said golf club shaft in a direction other than parallel to said longitudinal axis.

34. (original) The apparatus of claim 33 wherein said means for applying an impulse comprises:

means for displacing said distal end of said golf club shaft in a direction other than parallel to said longitudinal axis; and

means for releasing said displaced distal end.

35. (original) The apparatus of claim 27 wherein said means for measuring comprises:

at least two energy reflective surfaces on said shaft at angles oblique to said vibration plane;

means for directing a respective energy beam at each of said reflective surfaces;

means for detecting a respective reflected beam reflected from each of said surfaces;

means for calculating from said detected beams distances of said surfaces from one or more fixed locations during said vibratory motion; and

means for deriving said out-of-plane displacement from said calculated distances.

36. (original) The apparatus of claim 35 wherein said respective energy beam is a beam of electromagnetic radiation.

37. (original) The apparatus of claim 36 wherein said beam is a light beam.

38. (original) The apparatus of claim 37 wherein said beam is a laser beam.

39. (original) The apparatus of claim 35 wherein:

said first one of said proximal end and said distal end of said golf club shaft is said proximal end; and

said second one of said proximal end and said distal end of said golf club shaft is said distal end; said apparatus further comprising:

a reaction mass for mounting on said distal end; wherein:

said reflective surfaces are on said reaction mass.

40. (original) The apparatus of claim 27 wherein:

said means for analyzing comprises means for plotting said out-of-plane displacements as a function of angle about said longitudinal axis; and

said means for calculating comprises means for determining a pair of opposed minimum displacements; wherein:

a line connecting said opposed minimum displacements defines said preferred angular orientation.

41-52. (canceled)

53. (original) Apparatus for determining a preferred angular orientation of a golf club shaft about

a longitudinal axis thereof, said golf club shaft having a proximal end for gripping by a golfer and a distal end for attachment to a golf club head, said apparatus comprising:

a clamp for immobilizing a first one of said proximal end and said distal end of said golf club shaft;

a vibration generator for initiating vibratory motion of a second one of said proximal end and said distal end of said golf club shaft in each of a plurality of vibration planes, each lying at a respective angular position about said longitudinal axis;

at least one sensor for, for each of said vibration planes, measuring maximum out-of-plane displacement of said second one of said proximal end and said distal end of said golf club shaft;

an analyzer for analyzing said measured displacements; and

a processor for calculating from said analyzed measured displacements said preferred angular orientation.

54. (original) The apparatus of claim 53 wherein:

said first one of said proximal end and said distal end of said golf club shaft is said proximal end; and

said second one of said proximal end and said distal end of said golf club shaft is said distal end.

55. (original) The apparatus of claim 53 further comprising a reaction mass for mounting on said distal end.

56. (original) The apparatus of claim 55 wherein said vibration generator applies an impulse to said golf club shaft in a direction other than parallel to said longitudinal axis.

57. (original) The apparatus of claim 56 wherein said vibration generator comprises an actuator for:

displacing said distal end of said golf club shaft in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

58. (original) The apparatus of claim 57 wherein said actuator:

attracts said reaction mass with an electromagnet; and

releasing said reaction mass by deactivating said electromagnet.

59. (original) The apparatus of claim 53 wherein said vibration generator applies an impulse to said golf club shaft in a direction other than parallel to said longitudinal axis.

60. (original) The apparatus of claim 59 wherein said vibration generator comprises an actuator for:

displacing said distal end of said golf club shaft in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

61. (original) The apparatus of claim 53 wherein said sensor measuring comprises:

at least two energy reflective surfaces mounted on said shaft at angles oblique to said vibration plane;

a respective beam generator for directing a respective energy beam at each of said reflective surfaces;

a respective detector to detect a respective reflected beam reflected from each of said surfaces; and

a processor for calculating from said detected beams distances of said surfaces from one or more fixed locations during said vibratory motion, and for deriving said out-of-plane displacement from said calculated distances.

62. (original) The apparatus of claim 61 wherein said respective energy beam is a beam of electromagnetic radiation.

63. (original) The apparatus of claim 62 wherein said beam is a light beam.

64. (original) The apparatus of claim 63 wherein said beam is a laser beam.

65. (original) The apparatus of claim 61 wherein:

said first one of said proximal end and said distal end of said golf club shaft is said proximal end; and

said second one of said proximal end and said distal end of said golf club shaft is said distal end; said apparatus further comprising:

a reaction mass for mounting on said distal end; wherein:

said reflective surfaces are on said reaction mass.

66. (original) The apparatus of claim 53 wherein:

said analyzer plots said out-of-plane displacements as a function of angle about said longitudinal axis; and

said processor determines a pair of opposed minimum displacements; wherein:

a line connecting said opposed minimum displacements defines said preferred angular orientation.

67-79. (canceled)

80. (original) A method of determining a preferred angular orientation of a structural member about a longitudinal axis thereof, said structural member having a proximal end and a distal end, said method comprising:

immobilizing a first one of said proximal end and said distal end of said structural member;

initiating vibratory motion of a second one of said proximal end and said distal end of said structural member in each of a plurality of vibration planes, each lying at a respective angular position about said longitudinal axis;

for each of said vibration planes, measuring maximum out-of-plane displacement of said second one of said proximal end and said distal end of said structural member;

analyzing said measured displacements; and

calculating from said analyzed measured displacements said preferred angular orientation.

81. (original) The method of claim 80 wherein:

said first one of said proximal end and said distal end of said structural member is said proximal end; and

said second one of said proximal end and said distal end of said structural member is said distal end.

82. (original) The method of claim 80 further comprising mounting a reaction mass on said distal end prior to said initiating.

83. (original) The method of claim 82 wherein said initiating comprises applying an impulse to said structural member in a direction other than parallel to said longitudinal axis.

84. (original) The method of claim 83 wherein said applying an impulse comprises:

displacing said distal end of said structural member in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

85. (original) The method of claim 84 wherein:

said displacing comprises attracting said reaction mass with an electromagnet; and

said releasing comprises deactivating said electromagnet.

86. (original) The method of claim 80 wherein said initiating comprises applying an impulse to said structural member in a direction other than parallel to said longitudinal axis.

87. (original) The method of claim 86 wherein said applying an impulse comprises:

displacing said distal end of said structural member in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

88. (original) The method of claim 80 wherein said measuring comprises:

providing on said shaft at least two energy reflective surfaces at angles oblique to said vibration plane;

directing a respective energy beam at each of said reflective surfaces;

detecting a respective reflected beam reflected from each of said surfaces;

calculating from said detected beams distances of said surfaces from one or more fixed locations during said vibratory motion; and

deriving said out-of-plane displacement from said calculated distances.

89. (original) The method of claim 88 wherein said respective energy beam is a beam of electromagnetic radiation.

90. (original) The method of claim 89 wherein said beam is a light beam.

91. (original) The method of claim 90 wherein said beam is a laser beam.

92. (original) The method of claim 88 wherein:

said first one of said proximal end and said distal end of said structural member is said proximal end; and

said second one of said proximal end and said distal end of said structural member is said distal end; said method further comprising:

mounting a reaction mass on said distal end prior to said initiating; wherein:

said reflective surfaces are on said reaction mass.

93. (original) The method of claim 80 wherein:

said analyzing comprises plotting said out-of-plane displacements as a function of angle about said longitudinal axis; and

said calculating comprises determining a pair of opposed minimum displacements; wherein:

a line connecting said opposed minimum displacements defines said preferred angular orientation.

94-99. (canceled)

100. (original) Apparatus for determining a preferred angular orientation of a structural member about a longitudinal axis thereof, said structural member having a proximal end a distal end, said apparatus comprising:

means for immobilizing a first one of said proximal end and said distal end of said structural member;

means for initiating vibratory motion of a second one of said proximal end and said distal end of said structural member in each of a plurality of

vibration planes, each lying at a respective angular position about said longitudinal axis;

means for measuring, for each of said vibration planes, maximum out-of-plane displacement of said second one of said proximal end and said distal end of said structural member;

means for analyzing said measured displacements; and

means for calculating from said analyzed measured displacements said preferred angular orientation.

101. (original) The apparatus of claim 100 wherein:

said first one of said proximal end and said distal end of said structural member is said proximal end; and

said second one of said proximal end and said distal end of said structural member is said distal end.

102. (original) The apparatus of claim 100 further comprising reaction means for mounting on said distal end.

103. (original) The apparatus of claim 102 wherein said means for initiating comprises means for applying an impulse to said structural member in a direction other than parallel to said longitudinal axis.

104. (original) The apparatus of claim 103 wherein said means for applying an impulse comprises:

means for displacing said distal end of said structural member in a direction other than parallel to said longitudinal axis; and

means for releasing said displaced distal end.

105. (original) The apparatus of claim 104 wherein:

said means for displacing comprises an electromagnet for attracting said reaction mass; and

said means for releasing comprises means for deactivating said electromagnet.

106. (original) The apparatus of claim 100 wherein said means for initiating comprises means for applying an impulse to said structural member in a direction other than parallel to said longitudinal axis.

107. (original) The apparatus of claim 106 wherein said means for applying an impulse comprises:

means for displacing said distal end of said structural member in a direction other than parallel to said longitudinal axis; and

means for releasing said displaced distal end.

108. (original) The apparatus of claim 100 wherein said means for measuring comprises:

at least two energy reflective surfaces on said shaft at angles oblique to said vibration plane;

means for directing a respective energy beam at each of said reflective surfaces;

means for detecting a respective reflected beam reflected from each of said surfaces;

means for calculating from said detected beams distances of said surfaces from one or more fixed locations during said vibratory motion; and

means for deriving said out-of-plane displacement from said calculated distances.

109. (original) The apparatus of claim 108 wherein said respective energy beam is a beam of electromagnetic radiation.

110. (original) The apparatus of claim 109 wherein said beam is a light beam.

111. (original) The apparatus of claim 110 wherein said beam is a laser beam.

112. (original) The apparatus of claim 108 wherein:

said first one of said proximal end and said distal end of said structural member is said proximal end; and

said second one of said proximal end and said distal end of said structural member is said distal end; said apparatus further comprising:

a reaction mass for mounting on said distal end; wherein:

said reflective surfaces are on said reaction mass.

113. (original) The apparatus of claim 100 wherein:

said means for analyzing comprises means for plotting said out-of-plane displacements as a function of angle about said longitudinal axis; and

said means for calculating comprises means for determining a pair of opposed minimum displacements; wherein:

a line connecting said opposed minimum displacements defines said preferred angular orientation.

114-119. (canceled)

120. (original) Apparatus for determining a preferred angular orientation of a structural member about a longitudinal axis thereof, said structural member having a proximal end and a distal end, said apparatus comprising:

a clamp for immobilizing a first one of said proximal end and said distal end of said structural member;

a vibration generator for initiating vibratory motion of a second one of said proximal end and said distal end of said structural member in each of a plurality of vibration planes, each lying at a respective angular position about said longitudinal axis;

at least one sensor for, for each of said vibration planes, measuring maximum out-of-plane displacement of said second one of said proximal end and said distal end of said structural member;

an analyzer for analyzing said measured displacements; and

a processor for calculating from said analyzed measured displacements said preferred angular orientation.

121. (original) The apparatus of claim 120 wherein:

said first one of said proximal end and said distal end of said structural member is said proximal end; and

said second one of said proximal end and said distal end of said structural member is said distal end.

122. (original) The apparatus of claim 120 further comprising a reaction mass for mounting on said distal end.

123. (original) The apparatus of claim 122 wherein said vibration generator applies an impulse to said structural member in a direction other than parallel to said longitudinal axis.

124. (original) The apparatus of claim 123 wherein said vibration generator comprises an actuator for:

displacing said distal end of said structural member in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

125. (original) The apparatus of claim 124 wherein said actuator:

attracts said reaction mass with an electromagnet; and

releasing said reaction mass by deactivating said electromagnet.

126. (original) The apparatus of claim 120 wherein said vibration generator applies an impulse to said structural member in a direction other than parallel to said longitudinal axis.

127. (original) The apparatus of claim 126 wherein said vibration generator comprises an actuator for:

displacing said distal end of said structural member in a direction other than parallel to said longitudinal axis; and

releasing said displaced distal end.

128. (original) The apparatus of claim 120 wherein said sensor measuring comprises:

at least two energy reflective surfaces mounted on said shaft at angles oblique to said vibration plane;

a respective beam generator for directing a respective energy beam at each of said reflective surfaces;

a respective detector to detect a respective reflected beam reflected from each of said surfaces; and

a processor for calculating from said detected beams distances of said surfaces from one or more fixed locations during said vibratory motion, and for deriving said out-of-plane displacement from said calculated distances.

129. (original) The apparatus of claim 128 wherein said respective energy beam is a beam of electromagnetic radiation.

130. (original) The apparatus of claim 129 wherein said beam is a light beam.

131. (original) The apparatus of claim 130 wherein said beam is a laser beam.

132. (original) The apparatus of claim 128 wherein:

said first one of said proximal end and said distal end of said structural member is said proximal end; and

said second one of said proximal end and said distal end of said structural member is said distal end; said apparatus further comprising:

a reaction mass for mounting on said distal end; wherein:

said reflective surfaces are on said reaction mass.

133. (original) The apparatus of claim 120 wherein:

said analyzer plots said out-of-plane displacements as a function of angle about said longitudinal axis; and

said processor determines a pair of opposed minimum displacements; wherein:

a line connecting said opposed minimum displacements defines said preferred angular orientation.

134-140. (canceled)